IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application. An identifier indicating the status of each claim is provided.

Listing of Claims:

1. (Original) A circuit for detecting a shifted frequency, comprising:

a path selection unit for measuring a delay profile of a spread signal that has passed through a plurality of paths, and searching and selecting an optimum path from among said plurality of paths;

a plurality of finger processing units for reverse spreading the spread signal of each path, which is allocated by said path selection unit, by a spread code replica, obtaining a channel estimated value including at least phase variation component with respect to said path by using a given pilot symbol that is included in the signal after the reverse spread, and carrying out coherent detection by using said channel estimated value;

a phase difference measuring unit for measuring a phase difference from each phase variation component by each of said finger processing units;

a path timing difference measuring unit for measuring a periodical path timing difference depending on said delay profile;

a frequency error detecting unit for detecting a frequency error of said signal by using said path timing difference and said phase difference; and

a Doppler frequency detecting unit for detecting a Doppler frequency on the basis of said frequency error.

2. (Original) The circuit for detecting a shifted frequency according to claim 1, further comprising:

an average processing unit for averaging the frequency error from said frequency error detecting unit; and

a calculating unit for obtaining a difference between the frequency error after said averaging and a current frequency error,

wherein: said Doppler frequency detecting unit generates information representing said Doppler frequency on the basis of the frequency error after said calculation by said calculating unit.

3. (Original) The circuit for detecting a shifted frequency according to claim 1, wherein:

said phase difference measuring unit measures said phase difference by using only a phase variation component from said finger processing unit, to which a path having the maximum signal amplitude is allocated.

4. (Original) The circuit for detecting a shifted frequency according to claim 1, wherein:

said phase difference measuring unit measures said phase difference by using a signal that is obtained by combining said each phase variation component in a maximum ratio corresponding to a signal amplitude of each path, which is allocated to each of said finger processing units.

5. (Original) The circuit for detecting a shifted frequency according to claim 1, wherein:

each slot is provided with a plurality of said pilot symbols;

said phase difference measuring unit obtains a first phase difference that is measured from a phase variation component between respective pilot symbols within one slot and a second phase difference that is measured from a phase variation component between respective pilot symbol groups within at least two slots; and

said frequency error detecting unit detects a large frequency error by using said first phase difference and detects a minute frequency error by using said second phase difference.

6. (Original) The circuit for detecting a shifted frequency according to claim 1, wherein:

said path timing difference measuring unit measures said path timing difference by using only a delay profile corresponding to a path having a maximum signal amplitude, which exceeds a given threshold.

7. (Original) The circuit for detecting a shifted frequency according to claim 1, wherein:

said path timing difference measuring unit measures a path timing difference with respect to all paths having a signal amplitude exceeding a given threshold and combining each path timing difference in a maximum ratio corresponding to the signal amplitude of each path.

8. (Original) The circuit for detecting a shifted frequency according to claim 1, wherein:

said path selection unit averages said delay profile by a time period which is arbitrarily settable.

9. (Original) The circuit for detecting a shifted frequency according to claim 1, further comprising:

a combining unit for combining a signal after a coherent detection by each of finger processing units in a maximum ratio; and

a measuring unit for measuring a signal-to-interference ratio by using said signal combined in the maximum ratio, wherein:

said phase difference measuring unit generates reliability information of said phase difference by a measured value from said measuring unit to add the reliability information to said phase difference.

10. (Original) The circuit for detecting a shifted frequency according to claim 9, wherein:

said path timing difference measuring unit generates reliability information of said measured path timing difference and weights said measured path timing difference by said reliability information.

11. (Original) The circuit for detecting a shifted frequency according to claim 10, wherein:

said frequency error detecting unit compares the reliability information added to said phase difference with the reliability information added to said path timing difference and detects a frequency error by using either one of said phase difference and said path timing difference, which has a higher reliability.

12. (Original) The circuit for detecting a shifted frequency according to claim 10, wherein:

said frequency error detecting unit combines said phase difference and said path timing difference in the maximum ratio by using the reliability information added to said phase difference and the reliability information added to said path timing difference as weight, respectively, and detects a frequency error from the information after said combining in the maximum ratio.

13. (Original) A method for detecting a shifted frequency, comprising the steps of:

measuring a delay profile of a spread signal that has passed through a plurality of paths, and searching and selecting an optimum path from among said plurality of paths;

reverse spreading the spread signal of each path, which is allocated by said path selection, using a spread code replica, and obtaining a channel estimated value including at least phase variation component with respect to said path by using a given pilot symbol that is included in the signal after the reverse spread;

carrying out finger processing to perform coherent detection by using said channel estimated value;

measuring a phase difference from each phase variation component based on each finger processing;

measuring a periodical path timing difference by said delay profile;

detecting a frequency error of said signal by using said path timing difference and said phase difference; and

detecting a Doppler frequency on the basis of said frequency error.

14. (Original) The method for detecting a shifted frequency according to claim 13, further comprising the steps of:

averaging said frequency error; and

obtaining a difference between the frequency error after said averaging and a current frequency error, wherein:

upon detecting said Doppler frequency, information representing said Doppler frequency is generated on the basis of the frequency error after obtaining the difference.

15. (Original) The method for detecting a shifted frequency according to claim 13, wherein:

upon measuring said phase difference, said phase difference is measured by using only a phase variation component by the finger processing, to which a path having a maximum signal amplitude is allocated.

16. (Original) The method for detecting a shifted frequency according to claim 13, wherein:

upon measuring said phase difference, said phase difference is measured by using a signal that is obtained by combining said each phase variation component in a maximum ratio corresponding to a signal amplitude of each path, which is allocated by each of said finger processing.

17. (Original) The method for detecting a shifted frequency according to claim 13, wherein:

each slot is provided with a plurality of said pilot symbols, upon measuring the phase difference, a first phase difference that is measured from a phase variation component between respective pilot symbols within one slot and a second phase difference that is measured from a phase variation component between respective pilot symbol groups within at least two slots are obtained, and upon detecting said frequency error, a large frequency error is obtained by using said first phase difference, and a minute frequency error is obtained by using said second phase difference.

18. (Original) The method for detecting a shifted frequency according to claim 13, wherein:

upon measuring said path timing difference, said path timing difference is measured by using only a delay profile corresponding to a path having a maximum signal amplitude, which exceeds a given threshold.

19. (Original) The method for detecting a shifted frequency according to claim 13, wherein:

upon measuring said path timing difference, a path timing difference with respect to all paths having a signal amplitude exceeding a given threshold is measured and each path timing difference is combined in a maximum ratio corresponding to the signal amplitude of each path.

20. (Original) The method for detecting a shifted frequency according to claim 13, wherein:

upon said path selection, said delay profile is averaged by a time period which is arbitrarily settable.

21. (Original) The method for detecting a shifted frequency according to claim 13, further comprising the steps of:

combining a signal after a coherent detection by each of said finger processing in a maximum ratio; and

measuring a signal-to-interference ratio by using said signal combined in the maximum ratio, wherein:

upon measuring said phase difference, reliability information of said phase difference is generated from the measured value of the signal-to-interference ratio to add the reliability information to said phase difference.

22. (Original) The method for detecting a shifted frequency according to claim 21, wherein:

upon measuring said path timing difference, reliability information of said measured path timing difference is generated; and

said measured path timing difference is weighted depending on said reliability information.

23. (Original) The method for detecting a shifted frequency according to claim 22, wherein:

upon detecting said frequency error, the reliability information added to said phase difference is compared with the reliability information added to said path timing difference; and

a frequency error is detected by using either one of said phase difference and said path timing difference, which has a higher reliability.

24. (Original) The method for detecting a shifted frequency according to claim 22, wherein:

upon detecting said frequency error, said phase difference and said path timing difference are combined in a maximum ratio by using the reliability information added to said phase difference and the reliability information added to said path timing difference as weight, respectively, and a frequency error is detected from the value after being combined at the maximum ratio.

25. (Original) A portable communication apparatus having a circuit for detecting a shifted frequency, comprising:

a transmission and reception circuit for transmitting and receiving a signal that is spread by a spread code to and from a base station;

a path selection unit for measuring a delay profile of a received signal that has passed through a plurality of paths and has been received, and searching and selecting an optimum path from among said plurality of paths;

a plurality of finger processing units for reverse spreading a spread signal of each path, which is allocated by said path selection unit, using a spread code replica, obtaining a channel estimated value including at least phase variation component with respect to said path by using a given pilot symbol that is included in the signal after the reverse spread, and carrying out coherent detection by using said channel estimated value;

a phase difference measuring unit for measuring a phase difference from each phase variation component by each of said finger processing units;

a path timing difference measuring unit for measuring a periodical path timing difference depending on said delay profile;

a frequency error detecting unit for detecting a frequency error of said signal by using said path timing difference and said phase difference; and

a Doppler frequency detecting unit for detecting a Doppler frequency on the basis of said frequency error.

26. (Original) A portable communication apparatus, according to claim 25, wherein:

said path selection unit measures said delay profile by using a signal of a given common control channel as a phase reference for a downlink from the base station.

27. (Original) A portable communication apparatus, according to claim 25, wherein:

said path timing difference measuring unit measures said path timing difference by using a signal of a given common control channel as a phase reference for a downlink from the base station.

28. (Original) A portable communication apparatus, according to claim 25, wherein:

said phase difference measuring unit measures said phase difference from said phase variation component that is obtained from said pilot symbol that is included in a given individual channel of a downlink from the base station.

29. (Original) A portable communication apparatus, according to claim 25, further comprising:

a reference frequency signal generating unit for generating a reference frequency signal to be used upon said transmission and reception; and

an average processing unit for averaging a frequency error from said frequency error detecting unit; and

a frequency correction amount calculating unit for generating a correction amount to correct said reference frequency signal from the frequency error after said averaging.

30. (Original) A portable communication apparatus, according to claim 29, wherein:

said average processing unit averages said frequency error by a time period which is arbitrarily settable.

31. (Original) A portable communication apparatus, according to claim 25, further comprising:

a control information generating unit for generating control information to be used for at least control channel of an uplink; and

a control unit for controlling a transmission and reception property of said transmission and reception circuit, wherein:

said control information generating unit notifies said base station side of information in accordance with said detected Doppler frequency by inserting the information into a given individual control channel of an uplink, and said control unit optimum-controls a reception property of said transmission and reception circuit in response to a reply from the base station corresponding to said notification.

32. (Original) A portable communication apparatus, according to claim 25, further comprising:

a control information generating unit for generating control information to be used for at least an uplink control channel; and

a control unit for controlling a transmission and reception property of said transmission and reception circuit, wherein:

said control information generating unit judges whether or not a closed loop transmission diversity should be carried out in accordance with said detected Doppler frequency, notifies said

base station side of information in accordance with its detection result by inserting the information into a given individual uplink control channel, and said control unit optimally controls a reception property of said transmission and reception circuit in response to a reply from the base station corresponding to said notification.

33. (Canceled)